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January 5, 1995

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Mr. William F. Canton
Acting Secretary
Federal Communications Commission
1919 M. Street NW, Room 222
Washington D.C. 20554

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Dear Mr. Canton:

This letter is in comment to the proposed rule making for ANI/ALI with wireless devices.

The consulting and engineering firm of Elert & Associates fully supports the proposed rule making document regarding the wireless, cellular, and PBX devices. The widespread use of these various devices demands compatibility with Enhanced 911 systems to extend the same capabilities in case of emergency as those provided to traditional wired circuits.

Elert & Associates would like to submit the following comments in the form of experience we have in various options to this unique and urgent problem.

We are currently involved in the consulting and engineering of all aspect of Enhanced 911 systems, including assignment of latitude and longitude coordinates based on the Global Positioning Satellites (GPS) system. We couple this information with an accurate digital map in various GIS type software. We have also provided a copy of a draft technical white paper regarding three methods to provide answers to the E-911, cellular, PCS integration.

Additionally, one of the most promising, recent developments involves the use of existing commercial FM radio stations to provide Differential GPS (DGPS) signals for real time error correction.

The accuracy of standard GPS coordinate values with activated selective availability (SA) can be improved to ten (10) meters and + or - one (1) knot by employing DGPS. The DGPS method derives positional and rate information by evaluating satellite timing and land-based beacon signals.

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This approach assumes the FM station will superimpose or provide synchronized timing signals. This approach eliminates the need for individual counties or cities to construct GPS base stations. Although only a limited number of stations are currently on line, many areas of the United States are covered. Technically, it would seem to be only a period of time before most areas will be afforded this capability.

The application of this technology should provide ten (10) meter accuracy for the location of transmitting devices. The same level of accuracy is achievable with current maps and GIS mapping software at a reasonable cost.

This specific approach and degree of accuracy is fully acceptable for purposes of location identification in conjunction with Enhanced 911 systems. It follows, then, that coordination between the locally assigned, unique location address identification based on the inhabited structure driveway intersect point with the roadway or sheet provided by GPS latitude and longitude values will allow emergency responders to quickly locate the 911 caller.

We are currently under contract with various counties in multiple states engineering and managing 911 projects using this approach. We do continue to investigate other feasible methods.

Elert & Associates would be pleased to meet with you at any time to further discuss these or other methods.

Respectfully submitted,

Ed Hazelwood
Director of Public Safety and GIS

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Enclosure

E-911 Telephone-Cellular-PCS Integration

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Introduction

The primary concern facing public safety communication in light of expanding wireless use is how to locate wireless telephone users who call E-911. At this present these call are being forwarded to State Policies agencies. APCO's Project 31 is addressing this issue so 911 calls will provide an enhanced data screen to show location so that emergency units can quickly respond to these calls. Following location search techniques are presently being considered:

1. Direction Finding
2. Time of Arrival Differential
3. Geographic Positioning System

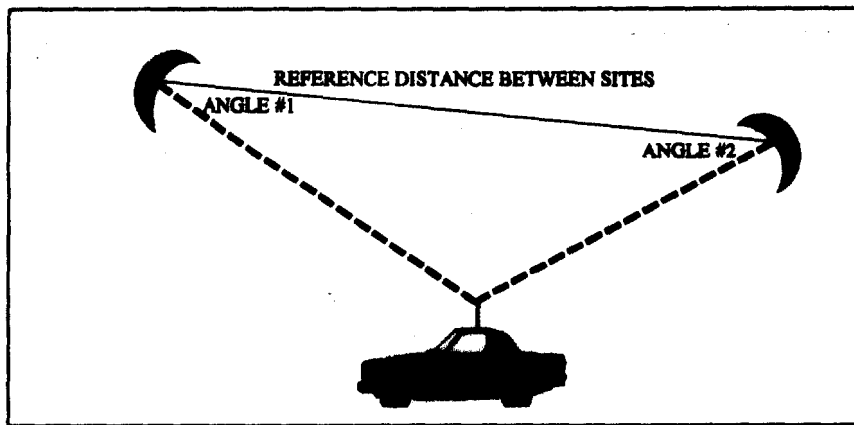
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Following are the pro and con highlights of these techniques:

	Direction Finding	Time of Arrival Differential	Global Positioning System
Accuracy	1000 feet	500 feet	50 feet
Base Mod.	Required	Required	None
Mobile Mod.	None	None	GPS Receiver
Impl. Cost	Very High	Low	Very High
Cost Bearer	PSAP	PSAP	Consumer
Acqu. Time	Very Long	Medium	Data Transmission Time
Data Availability	Computed	Computed	Available
Position Fix	Poor	Medium	Excellent
# of Sites	Two (2)	Three (3)	One (1)
# of Cells	One (1)	Three (3)	One (1)

Direction Finding

Direction Finding is extremely expensive, it requires a national network of expensive active directional antennae, such similar to Wollenweber arrays to achieve any reasonable acquisition time and directional accuracy. The information gathered with this technique can be ambiguous in an urban environment due to reflective structures. The acquisition time is too long for many emergency situations, it will be in terms of minutes.



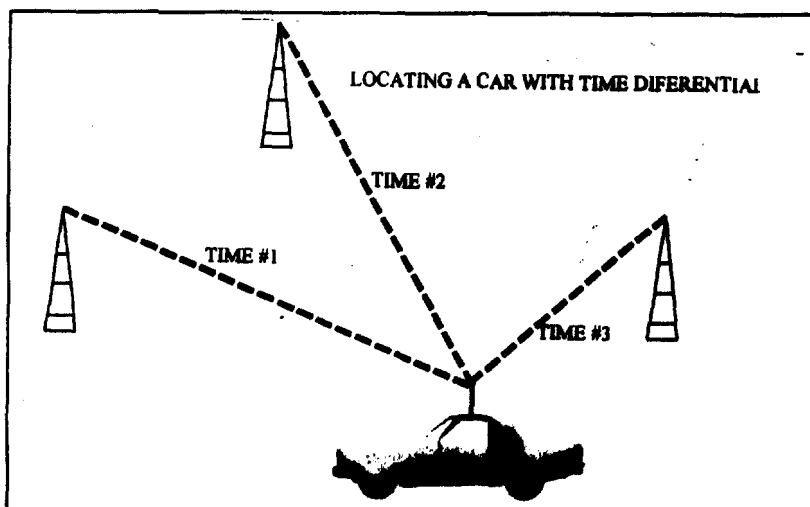
The widespread use of existing cellular equipment (15 million) favors the application of directional technology. Existing equipment are useable without redevelopment or modification.

One must realize, however, that this technology does not address the comprehensive dispatch and emergency response requirements of the future. The technical limitations and poor operational accuracy make the directional technology unsuitable for a long range solution to the mobile E911 and vehicle fleet control problem.

Time of Arrival Differential

The Time of Arrival Differential techniques computes the cellular caller's location from the time difference of arrival of the control channel signals. The caller's location is computed by evaluating the time difference of the cellular control signals between a minimum of three (3) cellular sites. The advantage of this technique is that existing, unmodified cellular equipment is used and that no additional or modified antenna sites are required. The addition of time reference links between cell sites and minor additional

hardware will integrate with the existing cellular transceivers. Multiple reflection from



reflective structures may present some problems.

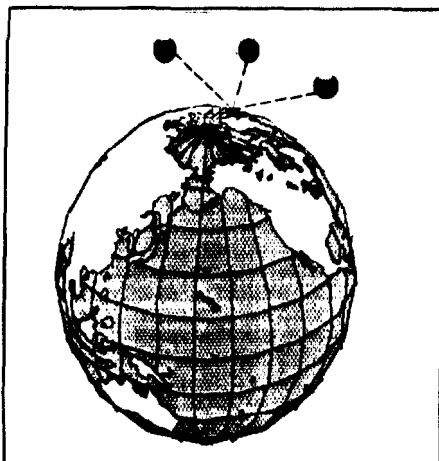
This technology can not be seen as a long term solution to the comprehensive public safety control problem. Inherent technical limitations restrict the precision of the system

and the nature of the same limits the range of applications. Its application is strictly limited to mobile E911 use with medium locating accuracy.

Global Positioning System

The most promising and most expensive, long term solution is to use the Global Positioning System (GPS). GPS is widely used in commercial and private navigation, it is under consideration for use in commercial aviation. Starting with the POLARIS Program the military has used GPS for the last three (3) decades. The primary problem with this solution is that communication equipment must incorporate a GPS receiver. The cost of these receivers has recently dropped from thousands of dollars to below \$400 and will

decrease more when additional applications are found.



GPS is a world-wide 24 satellite system with a "Selective Availability" (SA) positioning accuracy of approximately 50 feet. SA degrades the system accuracy for commercial use. Efforts are being made to remove SA and improve the positioning accuracy by an order of magnitude.

A GPS receiver determines its position from orbital parameters of satellites by evaluating the

received satellite signals. The world-wide commitment to GPS promises that this technology becomes the universal navigational tool with the expectation that the equipment price will reach a consumer affordable level. Some automobile manufacturers are starting to include mapping display equipment in their more expensive models.

Cellular Telephone Modification Requirements

Cellular Telephones with integrated microphone and head piece are not suitable for modification for operation with a GPS receiver. Future units must be developed with an incorporated GPS receiver; to preserve battery life these units will have to function "On Demand," only. The GPS unit will only receive and translate satellite data when placing a 911. Cellular phone user without GPS must be cautioned with a warning label informing them of the 911 limitations of their device. Mobile GPS receivers can operate in a continuous detection mode for fast coordinate acquisition.

Generally, cellular mobile units have a connector available for microphone and headset/loudspeaker. These units can interface with a GPS receiver and an associated modem for communication with PSAPs. Geographic data will be forwarded to the PSAP via a Cellular Telephone Switching Office (CTSO) and the Public Switched Telephone Network (PSTN) after the cellular call has been switched through to the PSAP; that is when the call is answered and the voice path is established.

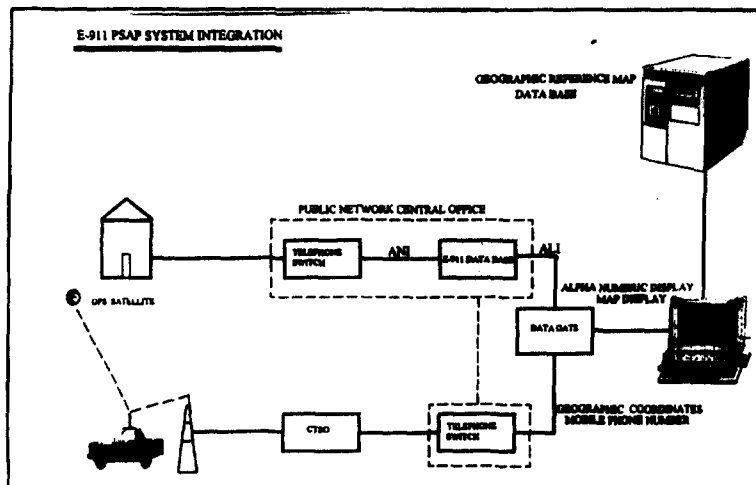
Integrating the Cellular Network into E-911

The PSAP data base for the Public Telephone E-911 Network stores telephone number, subscriber name, subscriber's address and a field for alpha-numeric information, which pertains the caller's location and/or circumstances. Latitude and longitude of subscriber will be added to the PSAP's data base in the near future. The responsibility for maintaining the data base vests with the local telephone operating company.

The requirement for Cellular E-911 is that the customers of this service be able to obtain access to emergency service by dialing 9-1-1 without having to dial additional

digits. At present all identifying information is stripped by the Cellular Telephone Switching Office (CTSO).

The cellular service will not be required to maintain a data base. PSAPs will maintain their own coordinate map with highway, streets and landmarks. The geographic coordinates of the location of a caller are send directly in real time by the subscriber's



cellular phone. The CTSO does also not have to supply Selective Routing (SR) information to redirect calls a to the proper PSAP. Selective Routing is performed by PSAPs from the geographic data received from the caller.

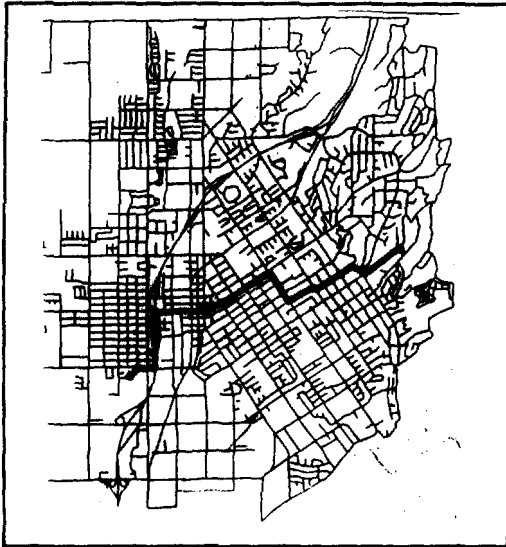
A Data Gate in the PSAP receives Public Network (ALI) and cellular data over separate dedicated lines identifying the network source of the information. Alternately, placing the Data Gate function in the central office and tagging the data source reduces the number of dedicated lines. The cellular data base and maintenance are the sole responsibility of the PSAP, which networks the data base to all associated dispatch centers and upgrades the data of all movable units periodically.

Source identification will be unnecessary once both the public and cellular data bases are uniform and derive all location information from the geographic coordinates.

There is an opportunity to extent the E-911 service to include locating missing vehicles. The required dual telephone recognizes two (2) telephone numbers; one for normal voice communication with active ring and the other for quite answer and GPS operation.

PSAP, Dispatch Center and Mobile Display.

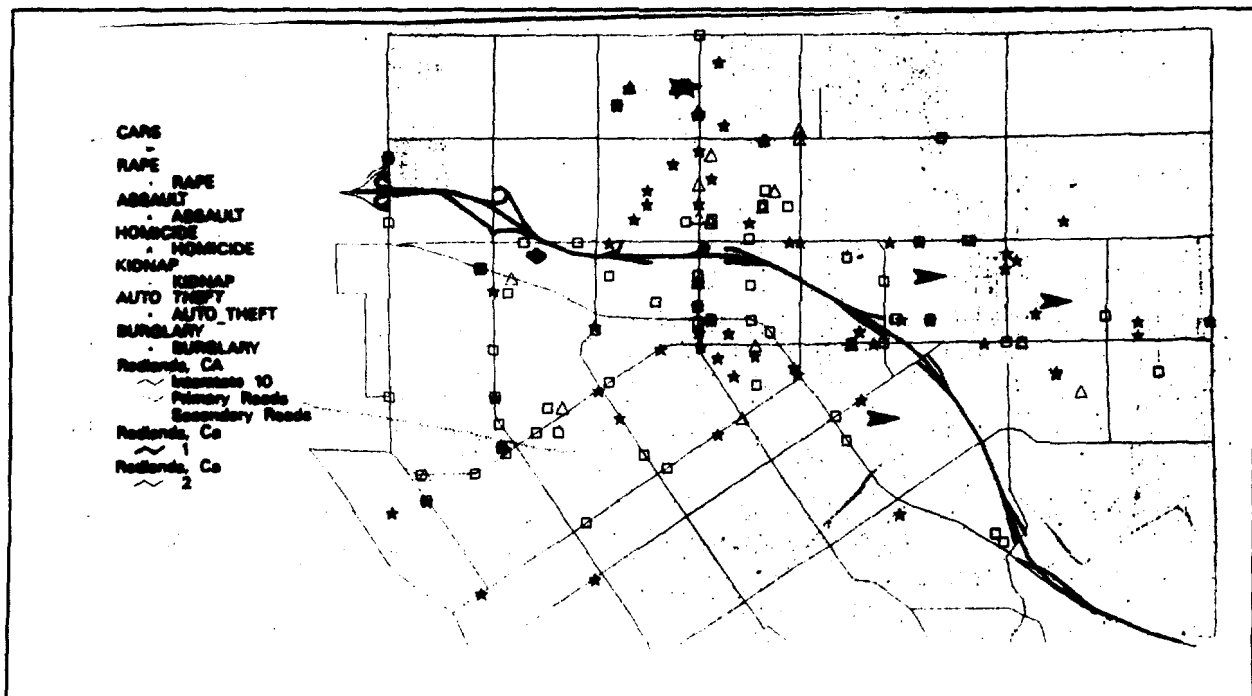
The first generation of E-911 information display equipment provides alpha-numeric data, which is forwarded to the responsible dispatcher. Dispatch routing and



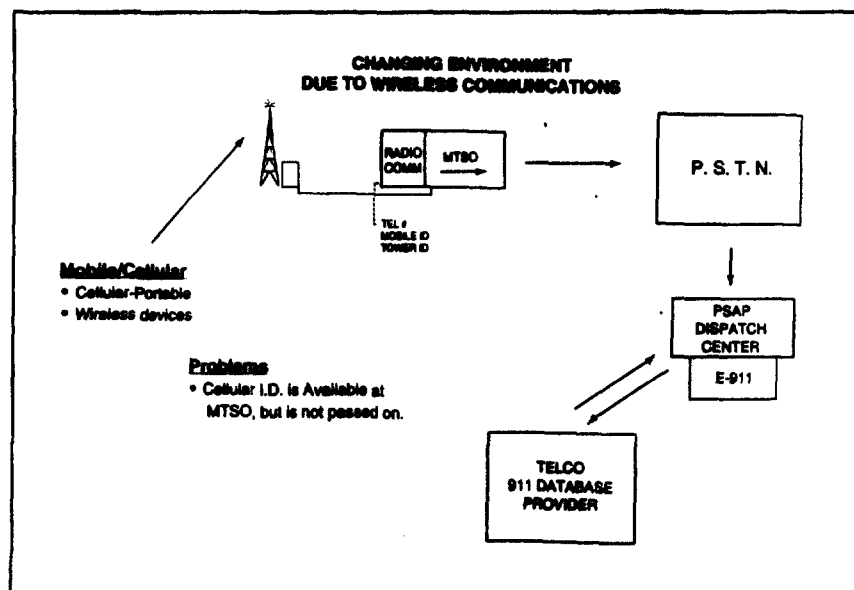
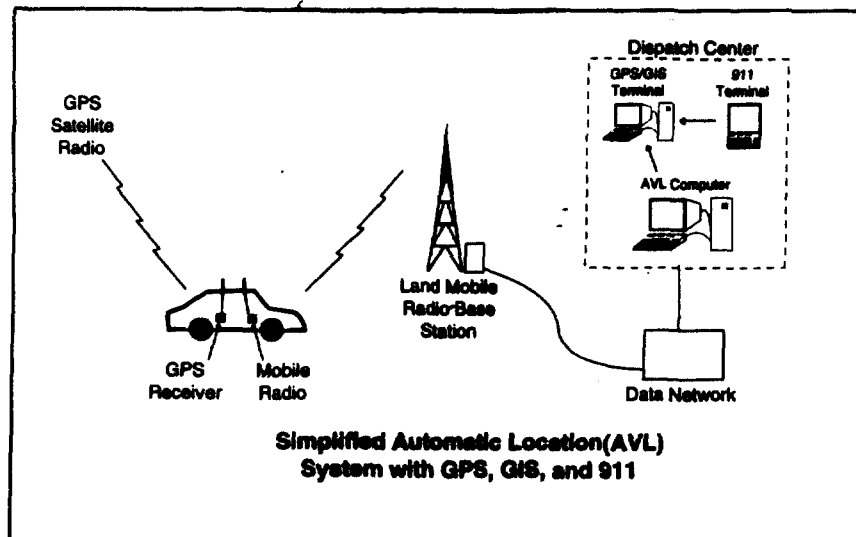
instruction are displayed in the PSAP as well as in all dispatch center.

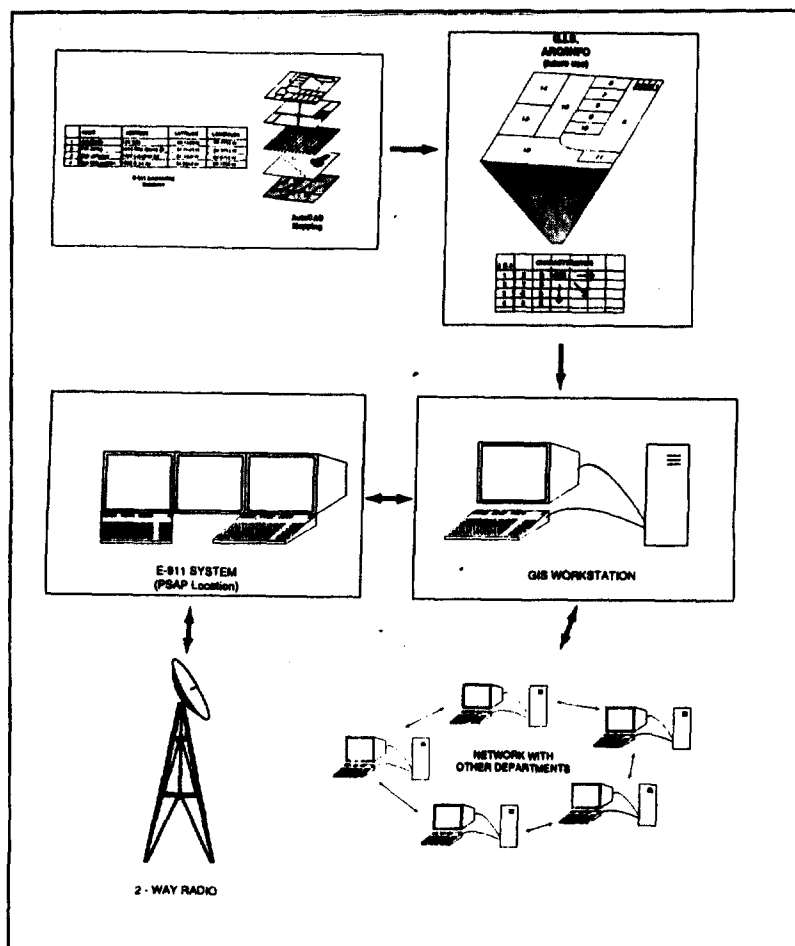
Emergency vehicles equip with similar, smaller display equipment will display, besides the area map, only information pertaining to its mission. A vehicular CAD display will illustrate the area map of its operational region, the vehicle's own location within the region, route obstructions, its destination and recommended route.

Display of Recommended Route



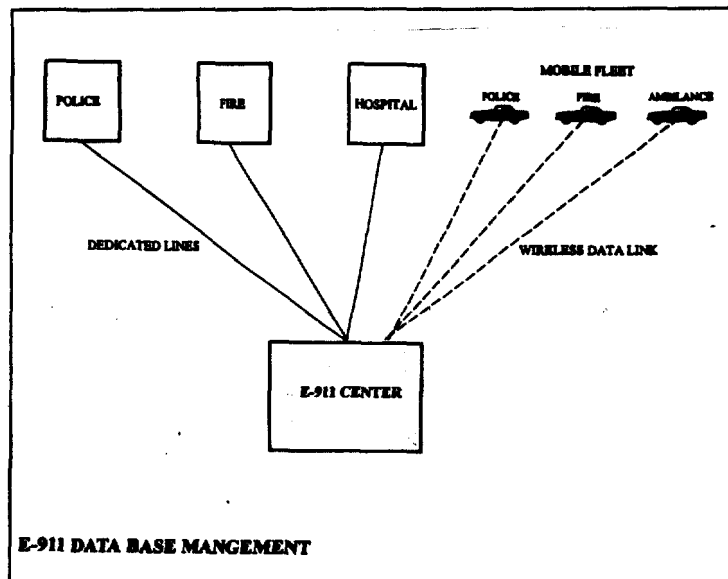
Typical Display of CAD Map with Vehicle and Emergency Codes





CAD Software

Sophisticated, user friendly Computer Aided Dispatch (CAD) software to meet all reporting and dispatch needs is readily available. These systems fulfill the requirements of most dispatchers needs in a wide range of agencies from a single, small police department to a county-wide E-911 system. The software advises the dispatcher and/or the E-911 center of the vehicular movements, road hazards, street directions, emergency locations and other pertinent facts. Tailored programs for police, fire, and EMS dispatch with complete compatibility with centralized E-911 software permit networking with all agencies. The modular organization of the CAD material permits functional expandability from simple map to complete interactive tracking display formats without disposing of incremental investments.



The data models are composed of graphic elements linking descriptive attributes in a relational database. Linear feature's, such as roads and rivers, are represented on a linear page. Geographic coordinates, point features, such as utility poles and fire hydrants, and dynamic objects, such as vehicles and emergency

sites, are represented in separate point pages or elements.

Limitations

GPS system operates in the giga hertz frequency region; the signals will not penetrate or bend around metal and concrete structures. Reflected signals cause excessive errors. Consequently, no useful signals reach GPS receivers in concrete buildings and enclosed vehicles. A highly reflective environment affects the accuracy of the received data too. Therefore, small, external GPS antennae are a **necessity** in vehicles.

Cellular ID of which the telephone number is of prime interest is stripped by the Cellular Telephone Switching Office. Telephone numbers are vital to effective PSAP operation. Some Caller ID information is required to avoid unnecessary dispatches due to crank calls and to permit immediate call-backs. The FCC must revise the operational specifications so that at a minimum the subscriber's name and cellular telephone number be forwarded to the Public Telephone Network.

Summary

This brief over view primarily addressed Cellular Network Enhanced 911; the same or similar criteria and solutions apply to wireless communication and PCS.

Wide-spread use of the GPS system in mobile and hand-held will occur when the demand for GPS equipment rises and the manufacturers can reduce the cost. The prognoses are good, since several automobile manufacturers starting to include the equipment as an option in more expensive cars. The application of this technology to small hand-held phones necessitates further advances in miniaturization. The last decade GPS receiver prices have dropped by an order of magnitude. Most existing mobile equipment are modifiable to interface with GPS receivers to forward geographic coordinates and its telephone number.

CAD equipment and programs for each phase of E-911 upgrade are readily available. In some applications it may be advisable to modify the visual appearance for improved display clarity and/or increased access speed.

The FCC must take action in corporation with industry to redefine the Cellular Network supervisory and transmission protocol. The transition to cellular E-911 requires several years with an extensive transmission period even after PSAPs are upgraded. During the phase-in period none conforming equipment must be clearly tagged with caution label explaining the limitations.